SAE Air Conditioning Standards

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SAE International

SAE International

Interior Climate Control Standards Committee ⟷ ISO

Five Sub-Committees

Industry Experts

Develop Documents

Members

- **Vehicle OEM/Tier one Suppliers**
- **A/C System and equipment Suppliers**
- **Chemical Industry**

Interior Climate Control Standards Committees

Vehicle OEM Steering Committee	Vehicle OEM Committee	MAC Suppliers Committee	Fluids Committee	Service Committee
13 Members Vehicle Manufacturers	Including OEM Steering Committee Members 17 Members	Including Vehicle OEM Steering Committee Members Includes Tier 1& 2 Suppliers 28 Members	Including Vehicle OEM Steering Committee Members Includes Tier 1& 2 Suppliers 23 Members	Including Vehicle OEM Steering Committee Members Includes Service Industry and Equipment Suppliers 30 Members

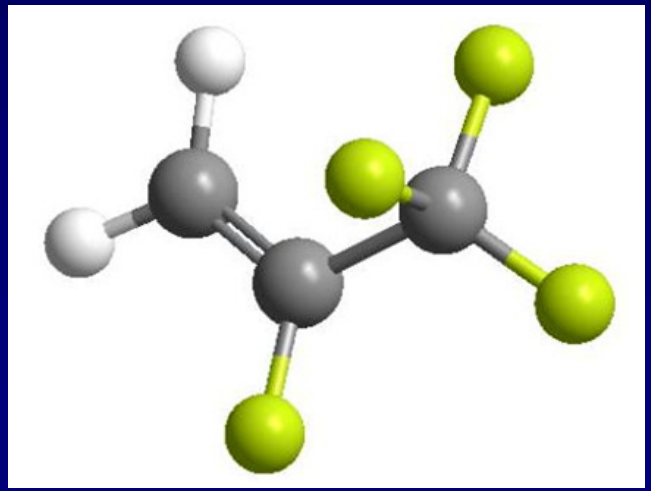
HFO-1234yf SAE Standards

(Under development or revision to be published in 2010)

- System Design
  - 5 - Documents
- Refrigerant
  - 1 - Document
- Service Equipment
  - 6 - Documents
- Service Fluids
  - 1 - Document

- Technician Requirements
  - 1- Document
- SAE Certification
  - A/C Components
  - Service Equipment
  - Technicians

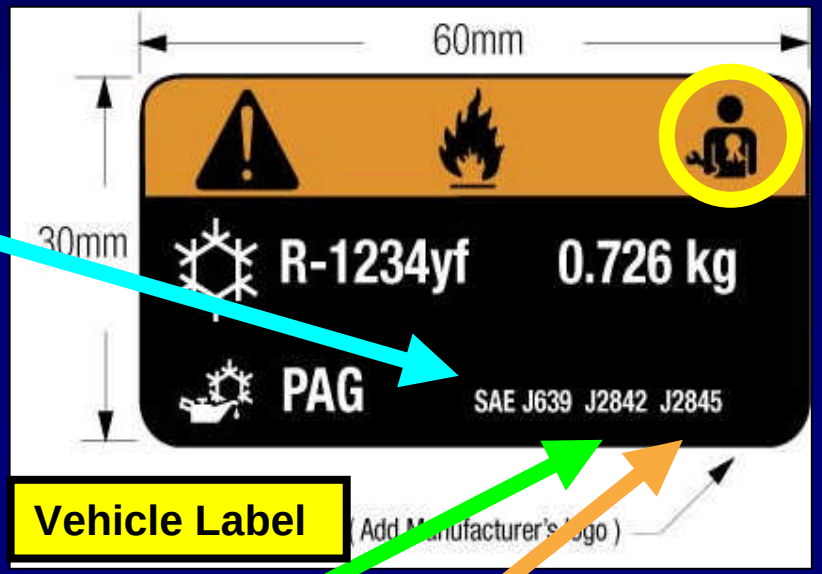
HFO-1234yf SAE Standards



- HFO-1234yf is a new refrigerant
  - When industry lists HFO-1234yf as a production refrigerant:
    - HFO-1234yf will be designated as R-1234yf and both designations can be used

SAE System Design Standards

- **J639 Safety Standards for Motor Vehicle Refrigerant Vapor Compression Systems**
  - This document provides design standards and safety requirements for MAC systems. Also included are cautionary statements for the mobile air conditioning service industry to alert service technicians to the inadvisability and the possible health and safety effects associated with venting refrigerant during service.
- **Master Document referencing all MAC A/C Standards**



J2842 Certification for OEM Mobile Air Conditioning Evaporator and Service Replacements

J2845 Technician Training for Safe Service and Containment of Refrigerants

SAE System Design Standards

- J639 Provides requirements and identifies SAE J Standard requirements for MAC systems including:
  - System design requirements
    - FMEA J1739
      - System operation J2772 - J2773
      - System components J2064 - J2842 - J2844
  - Service Equipment

    J2843 - J2851 - J2888 - J2912 - J2913
  - Technician Certification

    J2845

SAE System Design Standards

- **J2772 Measurement of Passenger Compartment Refrigerant Concentrations under system refrigerant leakage conditions**
  - **Provides a method of test for use in risk assessment.**
  - **The purpose of this standard is to provide a procedure and conditions to evaluate the refrigerant concentration in a vehicle passenger compartment resulting from leakage of refrigerant from a Mobile Air Conditioning system (MAC).**
- **J2773 R-744 and HFO-1234yf Refrigerant Standard for Safety and Risk Analysis for use in Mobile Air Conditioning Systems**
  - **This standard describes the method to verify the risk of a vehicle A/C system with alternative refrigerants in design, production and assembly, operation and final scrapping.**

SAE System Design Standards

- **J2842 HFO-1234yf and R-744 Design Criteria and Certification for OEM Mobile Air Conditioning Evaporator and Service Replacements**
  - **This standard is intended to minimize any unnecessary exposure to persons, during normal use or servicing of a mobile air conditioning system using toxic or flammable refrigerants.**

SAE System Design Standards

- **SAE J2064 R-134a and HFO-1234yf Refrigerant Automotive Air-Conditioning Hose and Assemblies**
  - **This SAE Standard covers hose and hose assemblies intended for conducting liquid and gaseous R-134a and/or HFO-1234yf refrigerant in automotive air-conditioning systems. The hose shall be designed to minimize permeation of the refrigerant, contamination of the system, and to be functional over a temperature range of –30 to 125 °C.**

New requirements for field coupled hose assemblies

SAE Refrigerant Standard

- **J2844 Refrigerant Purity and Container Requirements for New HFO-1234yf Refrigerant Used in Mobile Air-Conditioning Systems**
  - **The purpose of this SAE Standard is to establish the minimum level of purity required and container specifications for HFO-1234yf refrigerant used in mobile air-conditioning (A/C) systems. The refrigerant shall meet all purity requirements as identified in this Standard and shall follow the sampling and analytical methods of testing described in AHRI Standard 700-2006 and in future AHRI-700 Standards that include HFO-1234yf.**

SAE Service Equipment Standards

- **J2843 HFO-1234yf Recovery/Recycling/Recharging Equipment for Flammable Refrigerants for Mobile Air-Conditioning Systems**
  - The purpose of this SAE Standard is to establish the specific minimum equipment requirements for recovery/recycle/recharge of HFO-1234yf that has been directly removed from, and is intended for reuse in, mobile air conditioning systems and system recharging of recycled or virgin HFO-1234yf.

- **J2851 HFO-1234yf Refrigerant Recovery Equipment for Mobile Automotive Air-Conditioning Systems**
  - The purpose of this SAE Standard is to provide minimum performance and operating feature requirements for the recovery of HFO-1234yf refrigerant to be returned to a refrigerant reclamation facility that will process it to the appropriate ARI 700 Standard or allow for recycling of the recovered refrigerant by using SAE J2843 certified equipment.

SAE Service Equipment Standards

- **J2888 HFO-1234yf Service Hose, Fittings and Couplers for Mobile Refrigerant Systems Service Equipment**
  - The purpose of this SAE Standard is to establish specific but unique fittings, couplers, and hoses for service equipment used in maintaining HFO-1234yf systems. This is necessary to avoid cross mixing of refrigerant and lubricants from other refrigerant systems. This standard applies only to systems specifically designed to use HFO-1234yf.
- **J2099 Standard of Purity for Recycled HFC-134a (R-134a) and HFO-1234yf (R-1234yf) or Use in Mobile Air-conditioning Systems**
  - The purpose of this SAE Standard is to establish the minimum level of purity required for on-site recycled HFC-134a (R-134a) and HFO-1234yf (R-1234yf) removed from, and intended for reuse in, mobile air-conditioning (A/C) systems.

SAE Service Equipment Standards

- **J2912 HFO-1234yf Refrigerant Identification Equipment for Use with Mobile Air Conditioning Systems**
  - The purpose of this SAE Standard is to establish criteria for refrigerant identification equipment intended for use with or without recycling equipment when removing refrigerant from Mobile Air-Conditioning (A/C) Systems or from refrigerant containers prior to charging a mobile A/C system.
- **J2913 HFO-1234yf Refrigerant Electronic Leak Detectors, Minimum Performance Criteria**
  - The purpose of this SAE Standard is to establish minimum performance criteria for a modern class of electronic probe- type leak detectors intended for use in automotive air conditioning systems with HFO-1234yf a A2 flammable refrigerant.

SAE Service Fluids Standards

- **J2670 Stability and Compatibility Criteria for Additives and Flushing Materials Intended for Use in R-134a and HFO-1234yf Vehicle Air-Conditioning Systems**
  - **The purpose of this standard is to provide testing and acceptance criteria to evaluate the stability and compatibility of chemicals, including flushing materials and additives (e.g., to enhance lubrication, durability, cooling performance, energy performance, prevent/fix leaks) intended for use in either R-134a or HFO-1234yf vehicle air conditioning systems *using belt-driven compressors.***

SAE Technician Requirements

- **J2845 Technician Training for Safe Service and Containment of Refrigerants Used in Mobile A/C Systems (R-744 and HFO-1234yf)**
  - **Technician training is required to ensure that recommended procedures are used for service and repair of mobile air conditioning systems using R-744 and HFO-1234yf. The technician must be trained to recognize which refrigerant is being handled, how to handle it safely and be equipped with the essential information, proper equipment and tools, which are unique to these refrigerants**

SAE Certification Standard

- SAE J2911 Procedure For Certification That Requirements For Mobile Air Conditioning System Components, Service Equipment and Service Technicians Meet SAE J Standards
  - The purpose of this Standard is to certify that the requirements of an SAE J Standard for MAC system components, service equipment and service technician qualification are met. Certification provides a means to assure a customer or a Regulatory Agency that the equipment delivers the advertised performance.

SAE Surface Vehicle Recommended Practice [Developed by Industry]

- **SAE J1739** [Issued July 1994 Revised June 2009] **Potential Failure Mode and Effects Analysis in Design (Design FMEA), Potential Failure Mode and Effects Analysis in Manufacturing and Assembly Processes (Process FMEA), and Potential Failure Mode and Effects Analysis for Machinery (Machinery FMEA)**
  - This document introduces the topic of potential Failure Mode and Effects Analysis (FMEA) and gives general guidance in the application of the technique.

SAE ICCC Standards references J1739 in:

- Design requirements such as in J639
  - Service Equipment Requirements

HFO-1234yf SAE Standards Summary

- How do the standards compare to R-134a?
- Developed new Standards in conjunction with refrigerant evaluation, addressing system design, equipment and technicians
- Added 5 new standards

Documents	R-134a	HFO-1234yf
J639	✓	✓
Refrigerant Purity	✓	✓
Measurement Compartment Concentrations		✓
Risk Analysis		✓
Evaporator Design		✓
Refrigerant Recovery	✓	✓
Recycle Charging Equipment		
Leak Detectors	✓	✓
Refrigerant Identification	✓	✓
Technician and Equipment		✓
Certification		
Technician Training		✓
Hose Assemblies	✓	✓ New Field Coupled

HFO-1234yf SAE Standards Summary

- **Current Status of 15 SAE J Documents**

SAE Document Status	Committee	Type
J639 Safety Standards for Motor Vehicle Refrigerant Vapor Compression Systems	OEM	28 Day
J2064 R134a and HFO-1234fy Refrigerant Automotive Air-Conditioning Hose and Assemblies	MAC	28 Day
J2065 Desiccant Testing for Vehicle Air conditioning Systems	Fluids	
J2099 Standard of Purity for Recycled HFC-134a (R-134a) and HFO-1234yf (R-1234yf) or Use in Mobile Air-conditioning Systems	Fluids	28 Day
J2670 Stability and Compatibility Criteria for Additives and Flushing Materials Intended for Use in R-134a and HFO-1234yf Vehicle Air-Conditioning Systems	Fluids	28 Day
J2772 Measurement of Passenger Compartment Refrigerant Concentrations under system refrigerant leakage conditions	OEM	14 Day
J2773 HFO-1234yf and R744 Refrigerant Standard for Safety and Risk Analysis for use in Mobile Air Conditioning Systems	OEM	28 Day
J2842 HFO-1234yf and R744 Design Criteria and Certification for OEM Mobile Air Conditioning Evaporator and Service Replacements	OEM & MAC	28 Day
J2843 HFO-1234yf Recovery/Recycling/Recharging Equipment for Flammable Refrigerants for Mobile Air-Conditioning Systems	Service	14 Day
J2844 HFO-1234yf New Refrigerant Purity and Container Requirements Used in Mobile Air-Conditioning Systems	Fluids	14 Day
J2845 Technician Training for Safe Service and Containment of Refrigerants Used in Mobile A/C Systems (R-744, and HFO-1234yf)	Service	28 Day
J2851 HFO-1234yf Refrigerant Recovery Equipment for Mobile Automotive Air-Conditioning Systems	Service	28 Day
J2888 HFO-1234yf Service Hose, Fittings and Couplers for Mobile Refrigerant Systems Service Equipment	Service	14 Day
J2911 Certification Requirements For Mobile Air Conditioning System Components, Service Equipment, and Service Technicians to Meet SAE J Standards	MAC & Service	28 Day
J2912 HFO-1234yf Refrigerant Identification Equipment for Use with Mobile Air Conditioning Systems	Service	28 Day
J2913 HFO-1234yf Refrigerant Electronic Leak Detectors, Minimum Performance Criteria	Service	28 Day

SAE Interior Climate Control Standards Committee

- **All standards are planned to be published in first quarter of 2010**
- **Many States reference SAE J639**
  - **Some are:**
    - **Arizona-Idaho-Kansas-North Dakota-Oklahoma-Texas**
  - **Compliance requires:**
    - **MAC System Design Requirements**
    - **MAC Servicing Requirements**

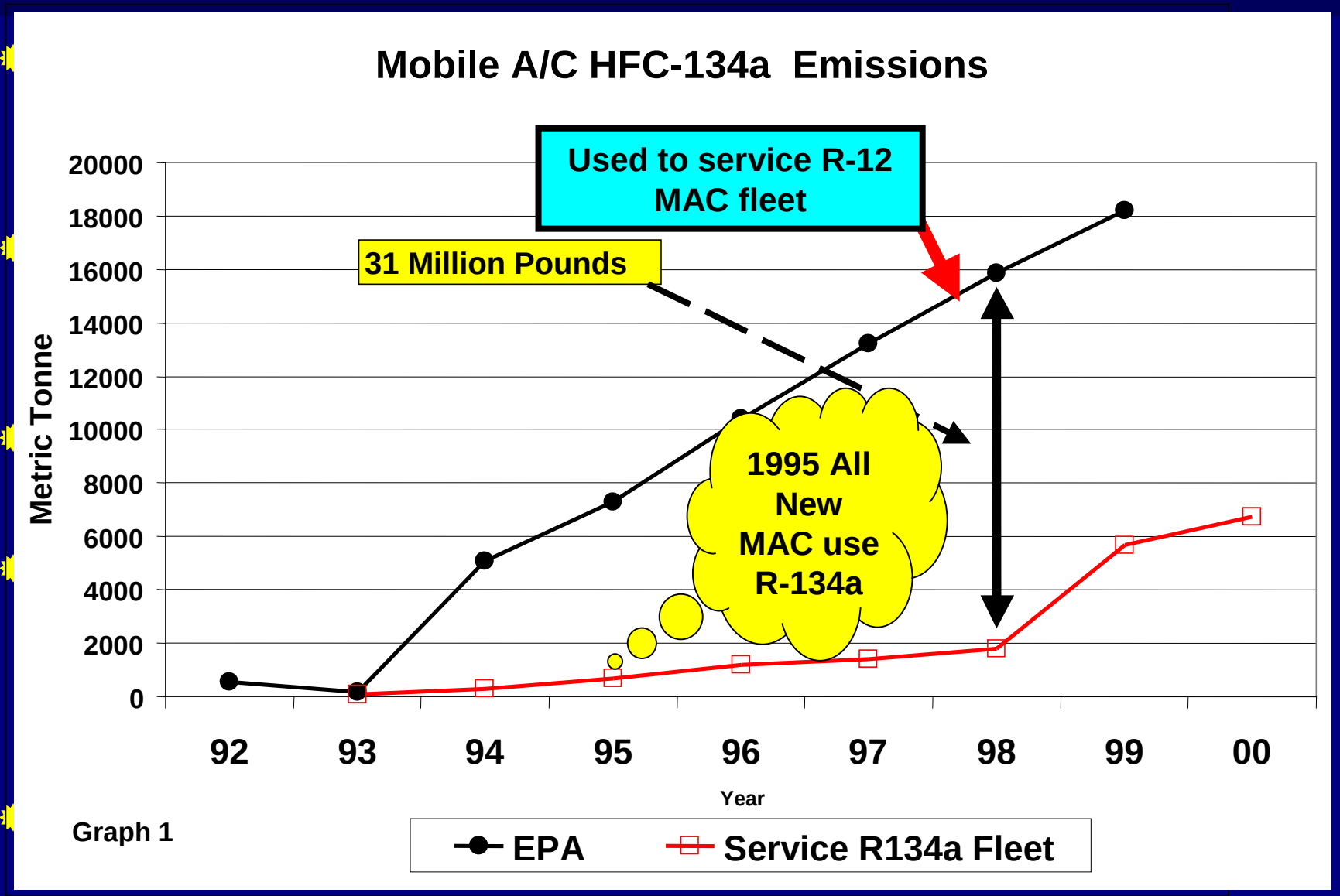
U.S. NCCTI Report October 12, 2001

- In the Executive Summary of Technologies to Reduce Emissions of Non-CO_2 Greenhouse Gases and Black Carbon National Climate Change Technology Initiative the following graph covers the emissions of HFC-134a

U.S. NCCTI Report October 12, 2001

- EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks 1999 and 2000 indicated emission levels for HFC-134a in 1992.
- HFC-134a systems first production MY1992 and full production MY1995
  - Refrigerant R&R was mandatory
- New HFC-134a systems required minimal refrigerant for service in 1993 –1998
- In 1998, an unexplained HFC-134a emissions, accountable to MAC service industry, of an additional 14,000 equivalent metric tonnes of carbon dioxide or 31 million pounds of HFC-134a
- HFC-134a was used to service the CFC-12 fleet

U.S. NCCTI Report October 12, 2001



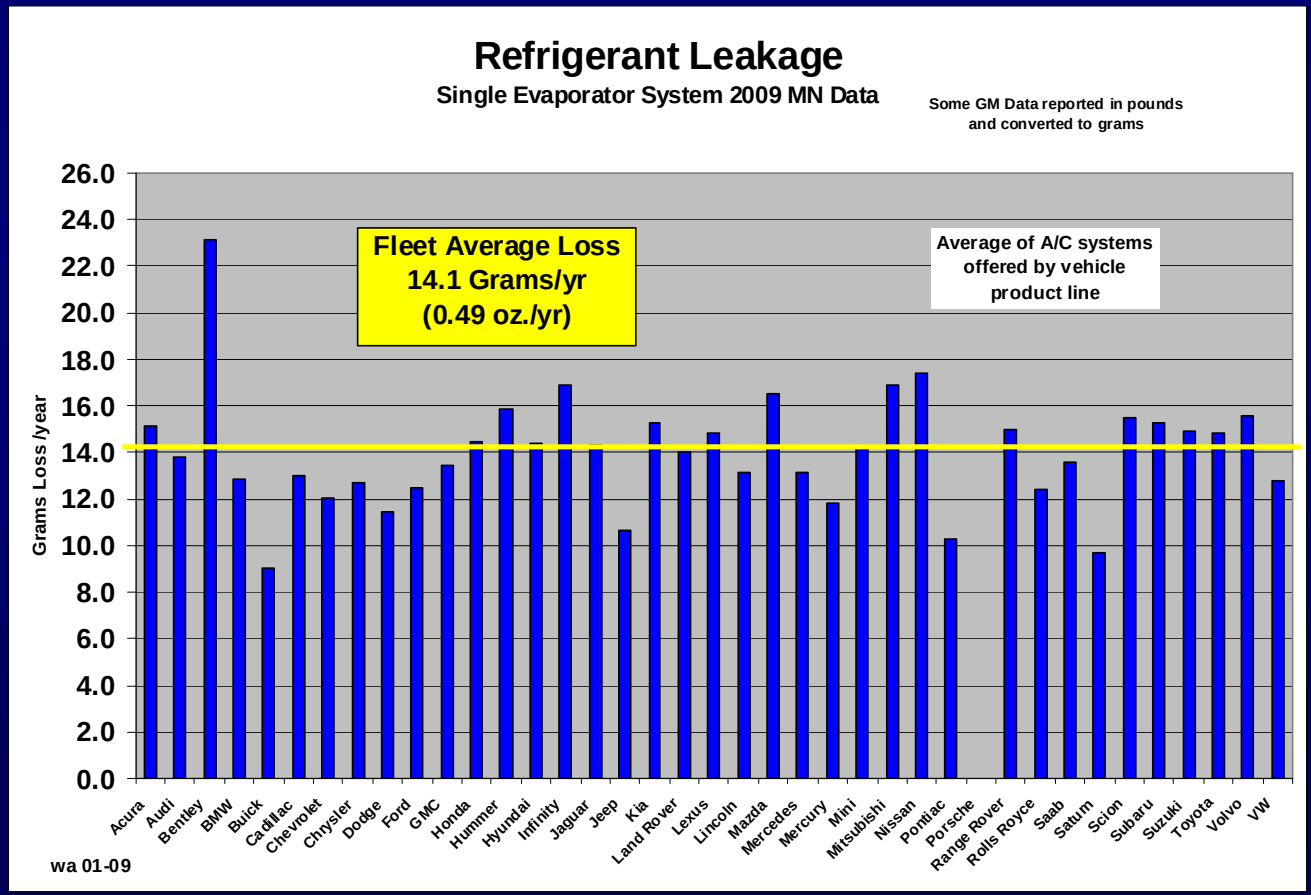
Graph 1

SAE Interior Climate Control Standards Committee

- **SAE J2727 HFC-134a Mobile Air Conditioning System Emission Chart**
  - **Estimates the annual refrigerant emissions rate (grams per year) from new production A/C systems**
- **Compliance Required**
  - **Currently Required in California Minnesota**
  - **Future Federal Requirement**

SAE J2727 HFC-134a Mobile Air Conditioning System Emission Chart

Annual refrigerant emissions rate (14.1grams [0.49oz] per year) from new production A/C systems



Future Challenges

- Introduction of HFO-1234yf in new vehicles
  - Refrigerant cost considerably higher
  - Cannot be vented at service
  - Requires all new service equipment
- Current EPA SNAP rule allows SNAP listed refrigerants
  - To service R-134a and potentially HFO-1234yf MAC systems

Current SNAP Listed Refrigerants

Refrigerant	USE Retrofit	Use New MAC	Contains HCFC's
FRIGC/FR-12 R-416A	X	X	Yes
Free Zone/ RB-276	X	X	Yes
Ikon 12	X	X	No
R-406A/GHGGHG, GHG-X3, GHG-12, McCool, Auto frost X3	X	X	Yes
GHG-HP	X	X	Yes
GHG-X4 R-414A Auto Frost, Chill-it, Autofrost X4	X	X	Yes
Hot Shot, Kar Kool R-414B	X	X	Yes
Freeze 12	X	X	Yes
GHG X-5	X	X	Yes
GHG-HP (HCFC Blend Lambda)	X	X	Yes
SP34E	X	X	No
RS-24 R-426A	X	X	No
HFC-134a	X	X	No
HFC-152a		X	No
CO2		X	No

- 15 SNAP Listed
- 9 Contain HCFC's!
- None can be vented
- All require unique fittings
- Can be used for retrofitting
  - 12 For HFC-134a systems
  - 13 For HFO-1234yf systems
- There are no SAE MAC System Retrofit procedures
- SAE Recovery/recycle Equipment Standards for only HFC-134a and HFO-1234yf refrigerants

Future Challenges

- Contamination potential for MAC systems and service equipment
  - Only recovery-recycle equipment will be available for HFC-134a and HFO-1234yf refrigerants
    - No certified R&R equipment designs exist for the other listed SNAP refrigerants
- No information on MAC system cooling performance or material compatibility for other SNAP listed refrigerants if used in HFC-134a or HFO-1234yf system

Lessons Learned
The Future

- The MAC change from CFC-12 to HFC-134a was expensive for the consumer and industry
- The laissez-faire use and atmospheric loading of HFC-134a has resulted in the current World action to eliminated its future use
  - Normal MAC HFC-134a direct refrigerant emissions is less than 5% over the MAC system lifetime
  - Vehicle tail pipe emissions for MAC energy use [cooling] results in greater lifetime emissions

Lessons Learned
The Future

- The high atmospheric HFC-134a loading is the result of refrigerant mis-use/mis-handling
- EPA controlled sale and use of CFC-12
- EPA did not control sale of HFC-134a

Lessons Learned
The Future

- The MAC change from HFC-134a to HFO-1234yf will be much more expensive for the consumer and industry
- Higher costs for:
  - Refrigerant
  - Systems
  - Service Equipment

Lessons Learned
The Future

- The HFC-134a world fleet is large
  - Refrigerant is required to retire the world HFC-134a fleet
  - Retrofitting the HFC-134a fleet is not acceptable
- HFC-134a has been used in MAC systems since 1992
- What is the future for MAC systems?
  - Current direct expansion type systems?
  - Secondary loop systems?
  - Multiple new refrigerants?

Lessons Learned
The Future

- EPA must revise the list of all SNAP MAC listed refrigerants and control their sale and use
- SNAP List should only include refrigerants which have been evaluated by industry and where SAE standards are established

Lessons Learned
The Future

- Refrigerants evaluated by industry
  - HFC-134a - HFO-1234yf – HFC-152a – R-744 [carbon dioxide]
  - Without SNAP revisions/controls:
    - Lower cost refrigerants will be used to service HFO-1234yf MAC systems
    - System contamination
    - Damage to MAC systems and service equipment will occur

Most contain POTENT ODS or GREENHOUSE GASES

Many Challanges For This Industry

Thank you for your time